

New species of *Pertusaria* from China

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Abstract

Seven new species, *Pertusaria paratropica* (with lichexanthone, hypothamnolic and salazinic acids), *P. parasommerfeltii* (with 4,5-dichlorolichexanthone and 2'-O-methylperlatolic acid), *P. qinbaensis* (with norstictic and stictic acids), *P. wenxianensis* (with norstictic acid and 4,5-dichlorolichexanthone), *P. sejilaensis* (with protocetraric acid), *P. subviolacea* (with hypothamnolic and cryptothamnolic acids) and *P. taibaiensis* (with norstictic acid), are reported from China.

Introduction

Pertusaria DC. is a globally distributed genus with a high biodiversity, and is polyphyletic with species belonging to different families within Pertusariales (Schmitt and Lumbsch 2004; Schmitt et al. 2010). Molecular data support that the genera *Gyalectaria* (Coccotremataceae) with gyalectoid ascomata and *Varicellaria* (Ochrolechiaceae) with lecanoric acid have been segregated or enlarged (Schmitt et al. 2010; Schmitt et al. 2012). Another two groups in *Pertusaria* are *Pertusaria* s. str.-group and *Variolaria*-group, but *Variolaria*-group is close to Ochrolechiaceae (Schmitt and Lumbsch 2004). The species of *Pertusaria* are differentiated by the apothecial structure, the number of ascospores per ascus, the structure of spores and chemistry (Dibben 1980; Archer 1997; Schmitt and Lumbsch 2004). A recent account of the lichen genus *Pertusaria* in China (Zhao et al. 2004) listed a total of 47 taxa, and over the past 10 years, an additional 21 species have been reported (Zhao et al. 2006a, b; Yang et al. 2008; Ren and Zhao 2008; Ren et al. 2008a, b; Ren et al. 2009a, b; Ren 2013; Ren and Kou 2013; Ren and Zhao 2014; Zhao et al. 2014). A continuing survey of *Pertusaria* species from China has been carried out, and an examination of some interesting or erroneously identified specimens has revealed the presence of seven new species, which are described and illustrated here.

Materials and methods

This paper is based on specimens deposited in SDNU (Lichen Section of Botanical Herbarium, Shandong Normal University), HMAS-L (Lichen Section of Herbarium, Institute of Microbiology, Chinese Academy of Sciences) and KUN (Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences). The morphology of the lichen specimens was examined using an Olympus SZ 51 stereomicroscope. Photographs of the thallus were taken with an OLYMPUS SZX16 camera with DP72. Colour reactions (spot tests) and the chemical constituents were identified using standard methods (Orange et al. 2001).

The species

Pertusaria paratropica Q. Ren, sp. nov. Fig. 1

MB 809839

Diagnosis: Similar to *Pertusaria tropica* Vain. but differs in possessing larger ascospores and containing salazinic acid.

Type: China, Yunnan: Fugong County, the west slope of Biluo Snow Mountain, alt. 2700 m, on dead twigs, Q. Ren 918, 28 May 2004; holotype HMAS-L.

Thallus grey to yellow-grey, moderately thick, epiphloedal, the margin \pm entire and unzoned, corticolous; soredia absent, but isidia sometimes present, granulate and crispy; upper surface smooth to tuberculate, somewhat shiny or matt, slightly fissured. Fertile verrucae white, hemispherical, numerous, well dispersed or occasionally crowded, 1–1.5(–2) mm in diam. Discs red-brown to black, 0.5–1 mm in diam., level or raised, heavily white-pruinose. Apothecia uncommon, usually 2–5 per verruca, fruit centre pink. Epithecium red-brown, K+ violet. Ascospores 1 per ascus, cylindric, 174–210 \times 61–68 μm ; ascospore wall single, 3–4 μm thick.

Chemistry: Thallus K+ yellow, C–, KC–, Pd+ deeply yellow, UV+ yellow. Secondary metabolites: lichexanthone (major), hypothamnolic acid (major), salazinic acid (major), decarboxyhypothamnolic acid (trace) and consalazinic acid (trace).

Etymology: From the Greek *para*, near, and the species' resemblance to *Pertusaria tropica* Vain.

Substrate and ecology: It grows on dead twigs or bark at altitudes between 1930 and 3000 m.

Comments: The new species belongs to *Variolaria*-group. It chemically resembles the tropical species *P. tropica*, but this species contains lichesterinic acid or 1'-methylhypothamnolate and elatinic acid in addition to hypothamnolic acid and \pm lichexanthone, and has smaller ascospores (115–180 \times 25–50 μm long) (Archer 1997; Elix et al. 2002).

Additional specimens examined: **China:** Yunnan: Gongshan County, Yeniugu, 27°48'45"N 98°49'51.8"E, alt. 2700 m, on stump, L.S. Wang 00-19337, 30 May 2000 (KUN); Dulongjiang Town, Longyuan Village, alt. 2400 m, on dead twigs, Q. Ren 372, 30 Aug 2002 (HMAS-L); Weixi County, the east slope of Biluo Snow Mountain, alt. 2600 m, on *Rhododendron* sp., Q. Ren 633, 31 May 2004 (HMAS-L); Lijiang City, Yulong Snow Mountain, the riverside of Baishuihe, alt. 3000 m, on *Pinus yunnanensis*, L.S. Wang 85-330, 6 Aug 1985 (KUN); Dali City, Mt. Cangshan, alt. 3000 m, on bark, Q. Ren 2011011, 14 Aug 2011 (SDNU). Sichuan: Luding County, the Camp 2 of Hailuogou, alt. 2456 m, L.S. Wang 96-17285, 28 Aug 1996 (KUN). Fujian: Mt. Wuyi, alt. 1930 m, on bark, Q. Ren 2012589, 5 Jan 2013 (SDNU). Chongqing: Mt. Jinfo, Fengchuling, alt. 2215 m, on dead twigs of *Rhododendron* sp., Q. Ren C249, 1 Oct 2001 (SDNU).

Pertusaria parasommerfeltii Q. Ren, sp. nov. Fig. 2

MB 807235

Diagnosis: Similar to *Pertusaria sommerfeltii* (Flörke) Fr., but differs in containing 2'-O-methylperlatolic acid in place of stictic acid.

Type: China: Shaanxi: Mt. Taibai, Mingxing Temple, alt. 2800 m, on *Pinus* sp., Q. Ren 2005328, 4 Aug 2005; holotype HMAS-L.

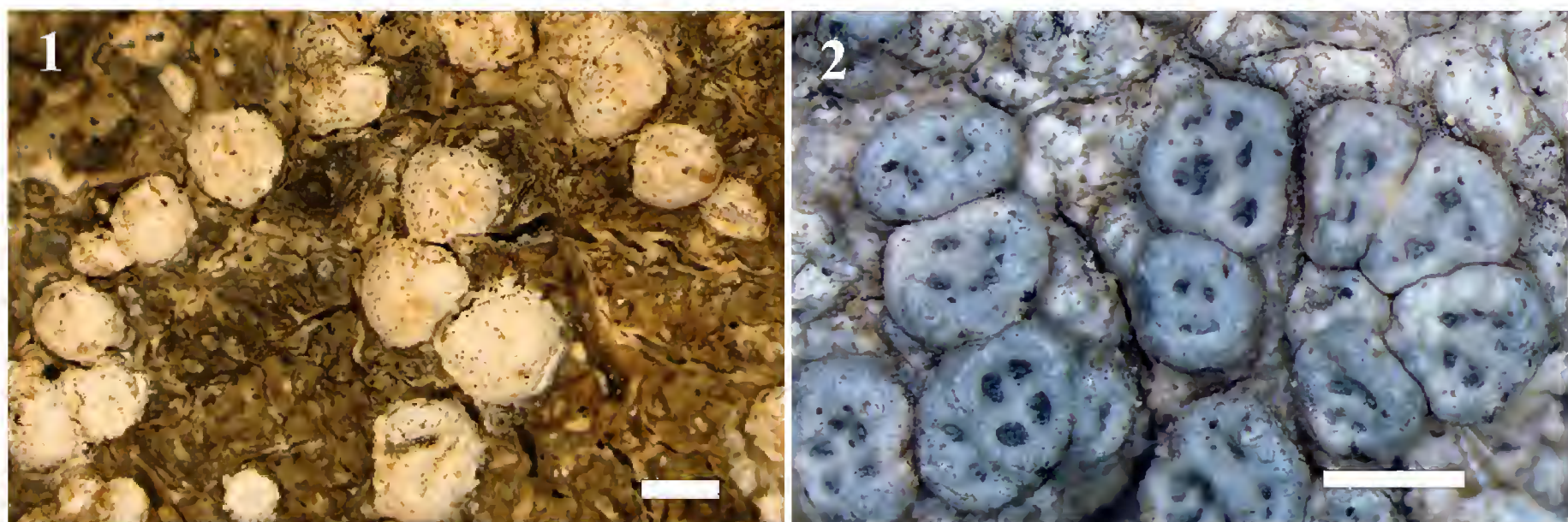


Fig. 1. *Pertusaria paratropica*, holotype. Scale bar = 1 mm. Fig. 2. *Pertusaria parasommerfeltii*, holotype. Scale bar = 1 mm.

Thallus grey or yellow-grey, epiphloedal, thin, the margin \pm entire and unzoned, corticolous. Upper surface smooth to tuberculate, shiny or matt; isidia and soredia absent. Fertile verrucae concolorous with the thallus, or sometimes darker, ampliariate, constricted, generally concave above, numerous, well dispersed, or locally crowded and occasionally fused, (0.8–) 1 (–1.5) mm in diam. Ostioles (1–) several per verruca, black, frequently grouped within 2–6 central depressions. Apothecia 1–5 per verruca, the fruit centre hyaline. Epithecium dark brown, K+ violet. Asci 8-spored. Ascospores hyaline, strictly uniseriate, ellipsoid or spherical, $20\text{--}30 \times 12\text{--}20 \mu\text{m}$; ascospore wall smooth, double, c. $2\text{--}3 \mu\text{m}$ thick, and end wall trimmed, c. $3\text{--}5 \mu\text{m}$ thick.

Chemistry: Cortex K–, C–, KC–, Pd–; medulla K–, C–, KC–, Pd–. Secondary metabolites: 4,5-dichlorolichexanthone and 2'-O-methylperlatolic acid.

Etymology: From the Greek *para*, near, and the resemblance of this species to *Pertusaria sommerfeltii* (Flörke) Fr.

Substrate and ecology: *Pertusaria parasommerfeltii* is a corticolous species and grows on conifers, such as *Picea* and *Pinus*, at altitudes between 2300 and 3300 m.

Comments: The new species is characterized by a yellow-grey, thin and shiny thallus; concave verrucae with several black ostioles often arranged in 2–6 central depressions; 8-spored asci with dominantly ellipsoid or spherical and strictly uniseriate spores; and the production of 4,5-dichlorolichexanthone and 2'-O-methylperlatolic acid. It belongs to *Pertusaria* s. str.-group. Previously reported erroneously from China as *Pertusaria sommerfeltii* (Flörke) Fr. (Zhao et al. 2004), but *P. sommerfeltii* has flat-topped verrucae with frequently blackened apices and contains 4,5-dichlorolichexanthone and stictic acid (Dibben 1980). The new species is morphologically and chemically similar to the Australian species *P. pertractata* Stirton (Stirton 1876, Kantvilas and Elix 2008) in that both species contain 4,5-dichlorolichexanthone and 2'-O-methylperlatolic acid and possess asci with eight ascospores but *P. parasommerfeltii* has conspicuous black ostioles and smaller ascospores, $20\text{--}30 \mu\text{m}$ long compared to $32\text{--}65\text{--}70 \mu\text{m}$ long in *P. pertractata*.

Additional specimens examined: China: Shaanxi: Mt. Taibai, Dadian, alt. 2300 m, on *Pinus armandii*, Q. Ren 2005377, 2 Aug 2005 (SDNU); Mingxing Temple, alt. 2800 m, on *Picea* sp., Q. Ren 2005331, 4 Aug 2005 (SDNU). Gansu: Zhouqu County, Muxutan, alt. 2500 m, on *Picea* sp., F. Yang 61407, 30 Jul 2006 (SDNU); Diebu County, Mt. Hutoushan, alt. 3200 m, on *Picea* sp., Z.F. Jia 61060, 25 Jul 2006 (SDNU). Heilongjiang: Muleng Town, Sanxinshan Forest Farm, on *Pinus* sp., J.C. Wei 2654, 23 Jul 1977 (HMAS–L). Yunnan: Lijiang City, Yunshan Ping, alt. 31000 m, on *Picea* sp., X.Y. Wang et al. 4806, 3 Aug 1981 (HMAS–L); Ganheba (c. 25 km NW of Lijiang City), alt. 3200–3300 m, on *Picea* sp., T.T. Ahti et al. 87-42645, 23 Apr 1987 (KUN).

Pertusaria qinbaensis Q. Ren, sp. nov. Fig. 3

MB 809840

Diagnosis: Similar to *Pertusaria himalayensis* Awasthi & Srivastava, but differs in having larger ascospores, epithecium K+ violet, and in containing additional stictic and consitictic acids.

Etymology: From the Latin *ensis*, place of origin, and the distribution in Qinshan Mountains and Daba Mountains.

Type: China: Shaanxi: Ningshan County, Pingheliang, alt. 2350 m, on *Betula platyphylla*, Sh. X. Guo & X. L. Shi SH005, 28 Jul 2005; holotype SDNU.

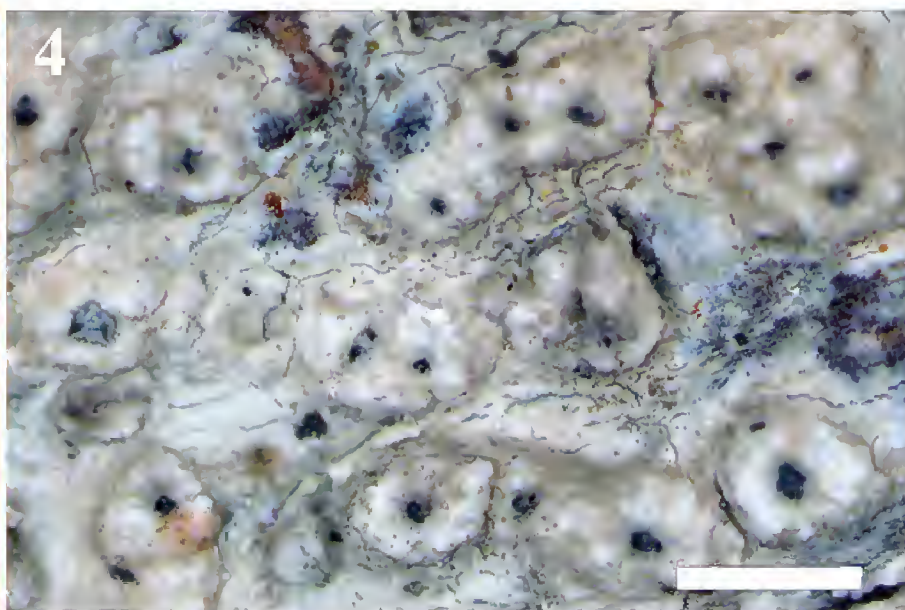


Fig. 3. *Pertusaria qinbaensis*, holotype. Scale bar = 1 mm.

Fig. 4. *Pertusaria wenxianensis*, holotype. Scale bar = 1 mm.

Thallus grey or yellow-grey, corticolous, epiphloedal, thin, the margin \pm entire and unzoned, corticolous; upper surface smooth, continuous, somewhat shiny; soredia and isidia absent. Fertile verrucae numerous, predominantly ampliariate or erect, conical to flat-topped, concolorous with the thallus or sometimes darker, well dispersed, occasionally fused, 0.4–0.5(–1) mm in diam. Ostioles 1 or 2–4 per verruca, conspicuous, black, level or lightly sunken, rarely grouped in a central depression. Apothecia 1 or 2–4 per verruca, the fruit centre hyaline. Epithecium dark, K+ violet. Asci 8-spored, cylindrical. Ascospores (4 or 6)8, predominantly biseriate, rarely irregular, ellipsoid to fusiform, 75–120 \times 30–55 μm ; ascospore wall smooth, c. 3–5 μm thick, and end wall trimmed, 7–10 μm thick.

Chemistry: Cortex K+ yellow becoming red, C–, KC–, Pd+ yellow; medulla K+ yellow becoming red, C–, KC–, Pd+ yellow. Secondary metabolites: norstictic acid (major), stictic acid (major) and constictic acid (minor).

Substrate and ecology: *Pertusaria qinbaensis* is a corticolous species, found in several localities in two different provinces. It grows on various barks such as *Betula* sp. and *Pinus* sp., or on dead twigs, at altitudes between 2300 and 2600 m.

Comments: *Pertusaria qinbaensis* belongs to *Pertusaria* s. str.-group, and it is characterized by a smooth and continuous thallus; ampliariate fertile verrucae with 1–4 black ostioles; 8-spored asci with biseriate, ellipsoid or fusiform ascospores; and the presence of norstictic and stictic acids. The new species is chemically similar to *Pertusaria himalayensis*, but the latter has smaller spores (48–88 μm long), epithecium K–, and lacks stictic acid (Awasthi and Srivastava 1993). Previously reported erroneously from China as *Pertusaria elliptica* Müll.Arg. (Yang et al. 2008), which is 3- or 4-spored and contains 2,5-dichlorolichexanthone, 2,4,5-trichlorolichexanthone, and stictic acid in the thallus (Archer 1997).

Additional specimens examined: China: Shaanxi: Ningshan County, Pingheliang, alt. 2300 m, on dead twigs J.Z. Zhao 958, 28 Jul 2005 (HMAS-L). Gansu: Wenxian County, Qiujiaba, alt. 2350 m, on *Pinus* sp., F. Yang 20070293, 4 Aug 2007 (SDNU); alt. 2550 m, on dead twigs, F. Yang 20070155, 3 Aug 2007 (SDNU); alt. 2600 m, on bark, F. Yang 20070182, 3 Aug 2007 (SDNU).

Pertusaria wenxianensis Q. Ren, sp. nov. Fig. 4

MB 809841

Diagnosis: Similar to *Pertusaria himalayensis* Awasthi & Srivastava, but differs in having smaller ascospores and in containing additional 4,5-dichlorolichexanthone.

Etymology: From the Latin *ensis*, place of origin, and Wenxian County.

Type: China: Gansu: Wenxian County, Qiujiaba, alt. 2360 m, on *Pinus* sp., F. Yang 20070104, 3 Aug 2007; holotype HMAS-L.

Thallus grey or ash-grey, corticolous, very thin, epiphloedal, margin \pm entire and unzoned, corticolous; upper surface smooth to tuberculate, continuous or lightly fissured, generally matt; soredia and isidia absent. Fertile verrucae numerous, dense, predominantly ampliariate or erect, usually flat-topped and tuberculate, occasionally elongate, (0.3–)0.5–1 mm in diam., concolorous with the thallus. Ostioles 1, 2 or 3 per verruca, black, conspicuous, level or lightly sunken, more often grouped in a central depression. Apothecia 1, 2 or 3 per verruca, the fruit centre hyaline. Epithecium dark, K+ strongly violet. Asci 8-spored, cylindrical. Ascospores (6 or)8, predominantly uniseriate, rarely irregular, ellipsoid, 28–40 (–50) \times 15–20 μm ; ascospore wall smooth, c. 3 μm thick, and the end wall at times trimmed, c. 5 μm thick.

Chemistry: Cortex K+ yellow becoming red, C–, KC–, Pd+ yellow; medulla K+ yellow becoming red, C–, KC–, Pd+ yellow. Secondary metabolites: norstictic acid and 4,5-dichlorolichexanthone.

Substrate and ecology: *Pertusaria wenxianensis* is a corticolous species, found in several localities in two provinces. It grows on *Pinus* or other kinds of barks at altitudes between 2250 and 4400 m.

Comments: *Pertusaria wenxianensis* belongs to *Pertusaria* s. str.-group, and it is characterized by a thin, marginally unzoned and matt thallus; numerous ampliariate fertile verrucae with the 1–3 black ostioles grouped in a depression; 8-spored asci with uniseriate, ellipsoid ascospores; and the presence of norstictic acid and 4,5-dichlorolichexanthone. The new species is chemically similar to *Pertusaria himalayensis*, but this species has larger ascospores (48–88 μm long), a K– epithecium and lacks 4,5-dichlorolichexanthone (Awasthi and Srivastava 1993). *Pertusaria wenxianensis* is also morphologically and chemically similar to the little known, Australian endemic species *P. undulata* Müll.Arg. (Müller 1893; Archer 1997) which also contains 4,5-dichlorolichexanthone and norstictic acid but possesses larger ascospores (67–85 μm long) and inconspicuous ostioles.

Additional specimens examined: China: Gansu: Wenxian County, Yigongduan of Qiujiaba, alt. 2450 m, on bark, *F. Yang* 20070033, 2 Aug 2007 (SDNU); Ergongduan of Qiujiaba, alt. 2360 m, on *Pinus* sp., *F. Yang* 20070079, 20070125, 20070114, 3 Aug 2007 (SDNU); alt. 2550 m, on bark, *F. Yang* 20070111, 3 Aug 2007 (KUN); alt. 2350 m, on *Pinus* sp., *F. Yang* 20070404, 20070389, 20070393, 5 Aug 2007 (SDNU). Xizang: Linzhi County, Lulang Town, Mt. Sejila, alt. 3300 m, on bark, *G.Y. Han* 20073100, 25 Oct 2007 (SDNU); alt. 4400 m, on *Rhododendron* sp., *G.Y. Han* 20073355-2, 27 Oct 2007 (SDNU).

***Pertusaria sejilaensis* Q. Ren, sp. nov. Fig. 5**

MB 809842

Diagnosis: Similar to *Pertusaria lacericans* A.W.Archer, but differs in having larger ascospores and conspicuous black discs.

Etymology: From the Latin *ensis*, place of origin, and Mt. Sejila in the Nyainqentanglha Mountains of the Tibetan Plateau.

Type: China: Xizang: Linzhi County, the east slope of Mt. Sejila, alt. 4120 m, on dead twigs, *G.Y. Han* 20073172, 26 Oct 2007; holotype SDNU.

Thallus ash-grey to yellowish grey, very thin to thin, epiphloedal, the margin \pm entire and unzoned, corticolous; soredia and isida absent; upper surface smooth to tuberculate, generally matt, continuous or fissured. Fertile verrucae lecanorate, concolorous with thallus, numerous, well dispersed or occasionally crowded, rarely fused, (0.3–)0.5–1 mm in diam., the verrucal margins crenulate or lacerate. Discs black, \pm 0.5 mm in diam., level, predominantly slightly or occasionally heavily white-pruinose. Apothecia mostly 1–2 per verruca, conspicuous, the fruit centre brownish. Epithecium brown, K–. Ascospores 1 per ascus, common, cylindrical, (190–)210–240(–250) \times 60–90 μ m; ascospore wall single, smooth, 3–5 μ m thick, and the end wall not trimmed.

Chemistry: Thallus K+ yellow, C–, KC+ pink, Pd+ deeply yellow. Secondary metabolite: protocetraric acid.

Substrate and ecology: On dead twigs or barks at altitudes between 3075 and 4300 m.

Comments: *Pertusaria sejilaensis* belongs to *Variolaria*-group, and it is characterized by a grey, thin and unzoned thallus; lecanorate fertile verrucae with 1 or 2 apothecia; black discs covered with slight pruina; 1-spored asci with large, cylindrical spores, the walls of which are smooth and not trimmed; and the production of protocetraric acid. The new species resembles *Pertusaria lacericans*, but this species has inconspicuous, immersed apothecia; ascospores uncommon and smaller (170–180 \times 35–40 μ m) and with a thinner spore wall (c. 1 μ m thick) (Archer 1997).

Additional specimens examined: China: Xizang: Linzhi County, Mt. Sejila, alt. 3300 m, on bark, *G.Y. Han* 20070111, 25 Oct 2007 (SDNU), 20073110-2 (SDNU); alt. 4110 m, on bark, *G.Y. Han* 20073156, 26 Oct 2007 (SDNU); alt. 4150 m, on dead twigs, *G.Y. Han* 20073284, 27 Oct 2007 (SDNU); alt. 4200 m, on bark, *G.Y. Han* 20073293, 27 Oct 2007 (SDNU); alt. 4280 m, on bark, *G.Y. Han* 20073259, 26 Oct 2007 (SDNU). Yunnan: Lijiang City, Mt. Laojun, alt. 3075 m, on bark, *Q. Ren* 4, 18 Oct 2002 (KUN); Xianggelila County, Shika Snow Mountain, alt. 4300 m, on bark, *H.Y. Wang* 20081221, 2 Nov. 2008 (SDNU).



Fig. 5. *Pertusaria sejilaensis*, holotype. Scale bar = 1 mm.



Fig. 6. *Pertusaria subviolacea*, holotype. Scale bar = 2 mm.

***Pertusaria subviolacea* Q. Ren, sp. nov. Fig. 6**

MB 809843

Diagnosis: Similar to *Pertusaria violacea* Oshio, but differs in containing hypothamnolic and cryptothamnolic acids.

Etymology: From the Latin, *sub*, under or somewhat, a reference to the similarity with the species *Pertusaria violacea*.

Type: China: Guizhou: Jiangkou County, Fanjingshan National Nature Reserve, 27°35'N 108°40'E, alt. 1875 m, on bark, Q. Ren 2012353, 9 Oct 2012; holotype HMAS-L.

Thallus ash-grey to grey, thin, epiphloedal, the margin entire and often zoned; upper surface smooth to tuberculate, generally matt, corticolous; isidia absent, but soredia present, granulate, often forming soralia; soralia round, convex, mainly located in the centre, dispersed or locally crowded to fused. Apothecia and pycnidia not seen.

Chemistry: Soralia K+ yellow quickly becoming purple, C+ pink, KC+ red, Pd+ deep yellow, UV–. Secondary metabolites: hypothamnolic acid (major) and cryptothamnolic acid (major).

Substrate and ecology: On bark.

Comments: *Pertusaria subviolacea* belongs to *Variolaria*-group, and it is characterized by a grey, thin and zoned thallus without apothecia; round and convex soralia; and the production of hypothamnolic and cryptothamnolic acids (both major metabolites). Morphologically, the new species is similar to the sterile *Pertusaria violacea*, but this species produces only thamnolic acid (Dibben 1980).

Additional specimens examined: China: Guizhou: Jiangkou County, Fanjingshan National Nature Reserve, 27°55'N 108°41'E, alt. 2150 m, on bark, Q. Ren 2012330, 9 Oct 2012 (KUN); alt. 1875 m, on bark, Q. Ren 2012371, 9 Oct 2012 (SDNU).

***Pertusaria taibaiensis* Q. Ren, sp. nov. Fig. 7**

MB 807234

Diagnosis: Similar to *Pertusaria californica* Dibben, but differs in having thinner walled spores and lacks papillate ostioles.

Type: China: Shaanxi, Mt. Taibai, Wengong Temple, alt. 3800 m, on siliceous rock, Q. Ren 2005349, 4 Aug 2005; holotype HMAS-L.

Thallus yellow-grey, epilithic, moderately thick to very thick, the margin ± entire and often zoned. Upper surface smooth to rugose-plicate, generally matt, deeply fissured and always areolate; isidia and soredia absent. Fertile verrucae concolorous with the thallus, pertusariate, more often flat-topped than hemisphaerical, frequently deformed, numerous and dispersed, at times crowded, 1–2(–3) mm in diam. Ostioles 1–8 per verruca, predominately black, level or slightly sunken but never papillate, well dispersed. Apothecia 1–8 per verruca, the fruit centre hyaline. Epithecium black, K–. Asci 2-spored; ascospores hyaline, ellipsoid, 120–250 × 45–70 μm. Ascospore wall smooth, c. 7 (–10) μm thick, with the end wall slightly trimmed, c. 14 μm thick.

Chemistry: Medulla K+ yellow becoming blood-red, C–, KC–, Pd+ orange. Secondary metabolite: norstictic acid.

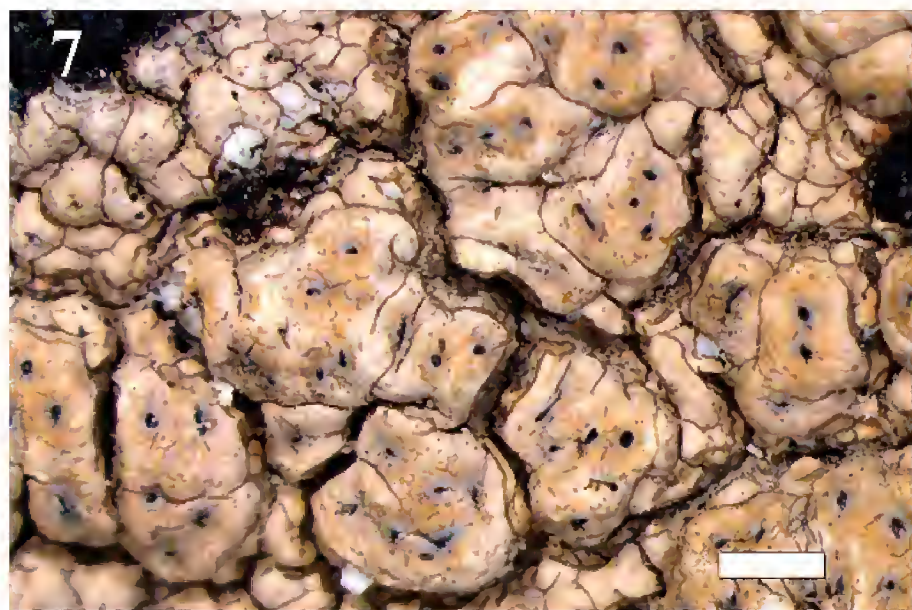


Fig. 7. *Pertusaria taibaiensis*, holotype. Scale bar = 1 mm.

Etymology: From the Latin *ensis*, place of origin, and Mt. Taibai, the main peak of the Qinling Mountains in central China.

Substrate and ecology: On siliceous rock, especially on the sunny side of the rock.

Comments: Diagnostic characters for the species are a yellow-grey, thick and areolate thallus; pertusariate verrucae that bear 1–8 black, never papillate, ostioles; 2-spored asci; ascospore wall smooth, the ends of which are slightly trimmed; and the production of norstictic acid. The new species belongs to *Pertusaria* s. str.-group, and previously reported erroneously from China as

Pertusaria plittiana Erichsen (Zhao et al. 2004), which is also saxicolous and 2-spored, but in this species the ascospore wall is rough and the medulla produces additional planaic and stenosporic acids. *Pertusaria taibaiensis* is most similar to *Pertusaria californica* Dibben in morphology and chemistry, but the latter is restricted to the coast and coastal mountains of central California, and has far thicker walled ascospores, outer spore wall (2–)5(–10) μm thick, inner spore wall (4–)13(–24) μm thick, ends of ascospores heavily trimmed, (12–)36(–68) μm thick, and predominately papillate ostioles (Dibben 1980).

Selected specimens examined: China: Shaanxi: Mt. Taibai, Ping'an Temple, alt. 2700 m, on siliceous rock, Q. Ren 2005321, 2005322, Aug 2005 (SDNU); Mingxing Temple, alt. 2800 m, on siliceous rock, Q. Ren 2005336, 4 Aug 2005 (SDNU); roadside between Dadian and Doumugong, alt. 2780 m, on siliceous rock, Q. Ren 2005347, 3 Aug 2005 (SDNU). Hubei: Shennongjia, the southeast slope of Da Shennongjia, alt. 2890 m, on rock, A.T. Liu 8401412, 29 Jul 1984 (HMAS–L 027885).

Acknowledgments

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